Quarterly Progress Report

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This is the second quarterly progress report on the project. The following is a brief summary of the progress on each of the three research thrusts described in the original proposal.

Assembly Planning Through Visualization

Three graduate students, Shiang-Fong Chen, Fay Gau, and Mei-Chu Cheng, have been working on this research project under the guidance of Dr. Lin-Lin Chen.

Shiang-Fong Chen, an MS student, has been working on automated generation of disassembly/assembly plans for two-dimensional assemblies. She has implemented an algorithm for generating disassembly plans by utilizing information that can be obtained from mating faces of components. The output of her program is a disassembly sequence and feasible directions for disassembling the components. This information is then fed into an animation program to simulate the disassembly process on an SGI workstation. She is currently extending her work to finding directions for separating two components which do not have mating faces.

Fay Gau, also an MS student, started in January to work on computing a representation of all directions in which a given surface is completely visible. Computation of these directions are critical in disassembly/assembly planning since they are the directions along which two components can separate without global interference. She has identified characteristics of the directions across which the a surface changes from completely visible to partially visible or to not visible. She has also implemented a graphical interface on an SGI workstation for displaying these directions as points, arcs, and regions on a unit sphere. A technical paper describing this algorithm is in preparation.

Mei-Chu Cheng, a Ph.D. student, has been developing and implementing an algorithm for identifying pocket (or cavity) features on a component. When separating a target component from another component, if the target component lies inside a pocket of the other component, then only the surfaces in the pocket might obstruct the disassembly of the target component. Therefore, by identifying and concentrating on the pocket that contains the target component, the number of surfaces need to be tested for global interference can be greatly reduced.
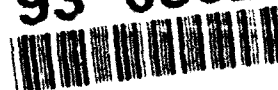
Off-line Programming and Visualization of Robots

Two graduate students, Darren Knapp (an MS student) and Jim Troy (a Ph.D candidate) are supported by the grant and are conducting research under the guidance of Professor Martin Vanderploeg.

Development of the next generation of off-line programming software is underway. This software will enable programming of cooperative robots and machine tools. The software is being written to operate in the SGI Performer environment to facilitate VR applications.

Solid models of the manufacturing workcell at the Iowa Center for Emerging Manufacturing Technology have been developed to provide a virtual environment for evaluating off-line programming applications. Jim Troy and Jawad Mokhtar have written software to convert solid models generated in IDEAS and AutoCAD into the proper format for IRIS Performer. This will enable the use of existing models of the workcell's machines to be used directly in VR applications

Simulation and Verification of Material Removal Processes

The grant is currently supporting the research of Yunching Huang, a Ph.D. student working under the guidance of Professor James Oliver. Progress is continuing on the dexel-based NC simulation and dimensional verification algorithm. Several new example applications have been demonstrated, and research toward automated correction of five-axis tool paths is underway. This work is aimed at incorporating the tool chuck and holder mechanism into the verification algorithm. Spatial "senors" on these parts will interact with the dexel representation of the milling environment to indicate interference. Necessary corrective actions are calculated from the degree of interference encountered. An abstract for a technical paper describing the dexel-based NC simulation and verification technique has been accepted for the SIAM conference on Mathematical Methods for CAD/CAM. The university research foundation will soon apply for a patent on this technology.

Mr. Nirmal Nair, an MS student funded on another grant, will defend his thesis in April. His work on an interactive manufacturability assessment tool for press formed surfaces has recently been enhanced to incorporate an efficient assessment of forming strains (in addition to its current capability in blank development). A paper describing his work has been accepted for the 1993 ASME Design Automation Conference. In May, Mr. Nair will join this project pursue his doctoral research on virtual environments for forming processes.